CHAPTER 3

DETERMINATION OF FLOOR SLAB REQUIREMENTS

3-1. Vehicular loads.

The following traffic data are required to determine the floor slab thickness requirements:

— Types of vehicles
— Traffic volume by vehicle type
— Wheel loads, including the maximum single-axle and tandem-axle loading for trucks, forklift trucks, and tracked vehicles
— The average daily volume of traffic (ADV) which, in turn, determines the total traffic volume anticipated during the design life of the floor slab.

For floor slabs, the magnitude of the axle load is of far greater importance than the gross weight. Axle spacings generally are large enough so that there is little or no interaction between axles. Forklift truck traffic is expressed in terms of maximum axle load. Under maximum load conditions, weight carried by the drive axle of a forklift truck is normally 87 to 94 percent of the total gross weight of the loaded vehicle.

For tracked vehicles, the gross weight is evenly divided between two tracks, and the severity of the load can easily be expressed in terms of gross weight. For moving live loads, axle loading is far more important than the number of load repetitions. Full-scale experiments have shown that changes as little as 10 percent in the magnitude of axle loading are equivalent to changes of 300 to 400 percent in the number of load repetitions.

3-2. Traffic distribution.

To aid in evaluating traffic for the purposes of floor slab design, typical forklift trucks have been divided into six categories as follows:

Forklift Truck Category	*Forklift Truck Maximum Axle Load, kips*	*Maximum Load Capacity, kips*
I	5 to 10	2 to 4
II	10 to 15	4 to 6
III	15 to 25	6 to 10
IV	25 to 36	10 to 16
V	36 to 43	16 to 20
VI	43 to 120	20 to 52

When forklift trucks have axle loads less than 5 kips and the stationary live loads are less than 400 pounds per square foot, the floor slab should be designed in accordance with TM 5-809-2/AFM 88-3, Chap. 2. Vehicles other than forklift trucks such as conventional trucks shall be evaluated by considering each axle as one forklift truck axle of approximate weight. For example, a three-axle truck with axle loads of 6, 14, and 14 kips will be considered as three forklift truck axles, one in Category I and two in Category II. Tracked vehicles are categorized as follows:

Forklift Truck Category	*Tracked Vehicles Maximum Bross Weight, kips*
I	less than 40
II	40 to 60
III	60 to 90
IV	90 to 120

Categories for tracked vehicles may be substituted for the same category for forklift trucks.

3-3. Stationary live loads.

Floor slabs on grade should have adequate structural live loads. Since floor slabs are designed for moving live loads, the design should be checked for stationary live loading conditions. Table 3-1 lists values for maximum stationary live loads on floor slabs. For very heavy stationary live loads, the floor slab thicknesses listed in table 3-1 will control the design. Table 3-1 was prepared using the equation

$$w = 257.876s \sqrt{\frac{kh}{E}} \qquad \text{(eq 3-1)}$$

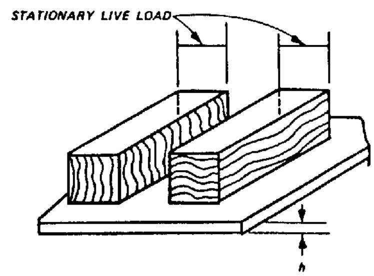
where

- w = the maximum allowable distributed stationary live load, pounds per square foot
- s = the allowable extreme fiber stress in tension excluding shrinkage stress and is assumed to be equal to one-half the normal 28-day concrete flexural strength, pounds per square inch
- k = the modulus of subgrade reaction, pounds per cubic inch
- h = the slab thickness, inches
- E= the modulus of elasticity for the slab (assumed to equal 4.0 x 106 pounds per square inch)

The above equation may be used to find allowable loads for combinations of values of s, h, and knot given in table 3-1. Further safety may be obtained by reducing allowable extreme fiber stress to a smaller percentage of the concrete flexural strength have been presented by Grieb and Werner, Waddell, and Hammitt (see Biblio). The selection of the modulus of subgrade reaction for use in table 3-1 is discussed in paragraph 4-2*d*. The design should be examined for the possibility of differential settlements which could result from nonuniform subgrade support. Also, consideration of the effects of long-term overall settlement for stationary live loads may be necessary for compressible soils (see TM 5-818-1/AFM 88-3, Chap. 7).

Table 3-1. Maximum allowable stationary live load

Slab Thickness	Stationary Live Load w in lb/ft^2 for These Flexural Strengths of Concrete			
inches h	550 lb in^2	600 lb in^2	650 lb in^2	700 lb in^2
6	868	947	1,026	1,105
7	938	1,023	1,109	1,194
8	1,003	1,094	1,185	1,276
9	1,064	1,160	1,257	1,354
10	1,121	1,223	1,325	1,427
11	1,176	1,283	1,390	1,497
12	1,228	1,340	1,452	1,563
14	1,326	1,447	1,568	1,689
16	1,418	1,547	1,676	1,805
18	1,504	1,641	1,778	1,915
20	1,586	1,730	1,874	2,018



NOTE: Stationary live loads tabulated above are based on a modulus of subgrade reaction (k) of 100 lb/in^3. Maximum allowable stationary live loads for other moduli of subgrade reaction will be computed by multiplying the above–tabulated loads by a constant factor. Constants for other subgrade moduli are tabulated below.

Modulus of Subgrade reaction	25	50	100	200	300
Constant factor	0.5	0.7	1.0	1.4	1.7

For other modulus of subgrade reaction values, the constant values may be found from the expression $\sqrt{k/100}$.

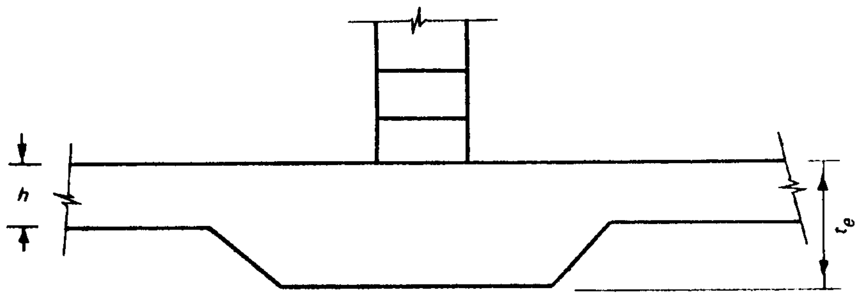
3-4. Wall loads.

Floor slabs on grade should have adequate thickness to carry wall loads. Tables 3-2 and 3-3 show the minimum thicknesses of thickened slabs for various wall loads. The equations used to compute these values are included in appendix B. When slab thickness required for wall loads exceeds that required for moving live loads or stationary live loads, the slab will be thickened in accordance with figure 3-1. The safety factor for the design was considered by using a reduced allowable tensile stress of the concrete, o_t , which was computed using the equation $o_t = 1.6 \sqrt{f'_c}$, where f'_c is the ultimate compressive strength of the concrete. If wall loads exceed the tabulated values shown in table 3-2, separate wall footings are suggested. Figure 3-l*a* shows the widths of thickened slabs when the interior wall loads are near the slab center. A recommended transition is also shown. The thickened slab width is determined by the same theory as the wall loads. The slab under the wall is widened to the point where the stress in the thinner slab section does not exceed the allowable tensile stress of $1.6 \sqrt{f'_c}$. Figure 3-1*b* shows a slab loaded near a keyed or doweled edge. Figure 3-lc shows a recommended slab thickening for a slab loaded near a free edge. The width of the thickened edge varies depending upon the width of the wall.

3-5. Unusual loads.

Information regarding floor slab requirements for special purpose ordnance, engineer, or transport vehicles producing loads significantly greater than those defined herein should be requested from Headquarters, Department of the Army (HQDA) (DAEN-ECE-G) Washington, DC 20314-1000 or Headquarters, Air Force Engineering and Services Center (DEMP), Tyndall MB, Fla. 32403.

Table 3-2. Minimum thickness of thickened floor slab for wall load near center of slab or near keyed or doweled joint



Thickness of Thickened Floor Slab, t_e, (inches)	Slab Line Load Capacity, P, (lb/lin ft) Flexural Strength[a] of Concrete (lb/in^2)			
	550	600	650	700
4	425	455	485	510
5	565	600	640	675
6	710	755	805	850
7	860	920	975	1,030
8	1,015	1,080	1,150	1,215
9	1,175	1,255	1,330	1,410
10	1,340	1,430	1,520	1,605

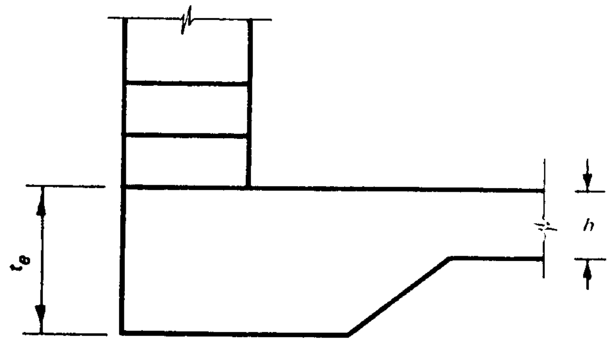
NOTE: The allowable wall loads are based on a modulus of subgrade reaction (k) of 100 pounds per cubic inch. The thickness of the thickened slab will be computed by multiplying the above thick– nesses by a constant factor. Constants for other subgrade moduli are tabulated below.

Modulus of Subgrade reaction k	25	50	100	200	300
Constant factor	1.3	1.1	1.0	0.9	0.8

For other modulus of subgrade reaction values the constant values may be found from $\sqrt[5]{100/k}$.

[a]For this application the flexural strength of concrete was assumed equal to $9\sqrt{f'_c}$ where f'_c is the specified compressive strength of concrete (lb/in^2).

Table 3-3. Maximum allowable wall load near free edge



Thickness of Thickened Slab, t_e (inches)	Slab Line Load Capacity, P, (lb/lin ft) Flexural Strength[a] of Concrete (lb/in^2)			
	550	600	650	700
4	330	355	375	395
5	435	465	495	525
6	550	585	620	660
7	665	710	755	800
8	785	840	890	945
9	910	975	1,035	1,090
10	1,040	1,110	1,180	1,245

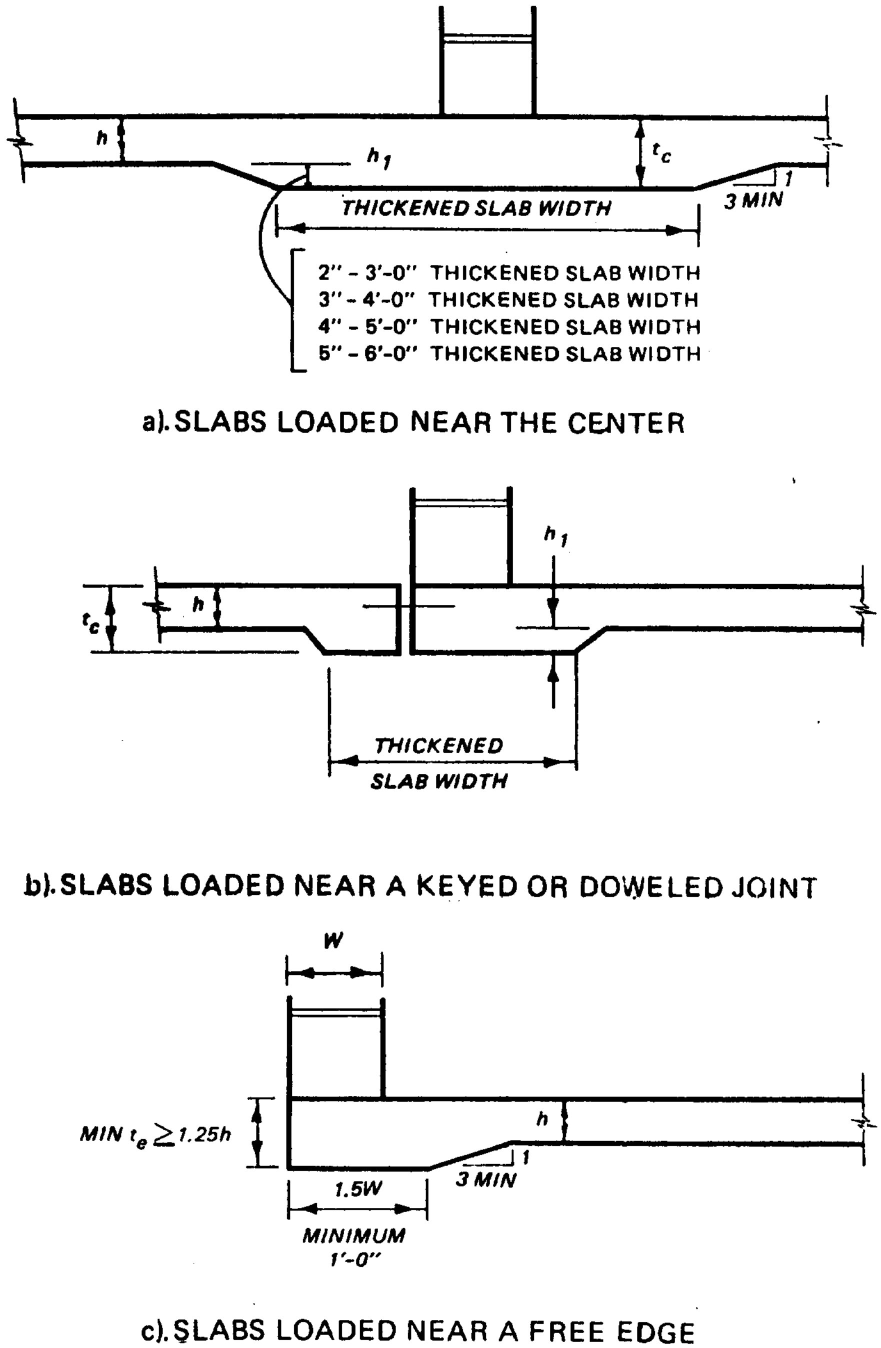


Figure 3-1. Widths of thickened slabs and slab edge conditions under wall loads.